

The conservationist's most important task, if we are to save the Earth, is to educate.

**Peter Scott, founder and chairman of the World Wildlife Federation**

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ENVIRONMENTAL EDUCATION

# Teaching Sustainability

"I want to make a case for fighting poverty, protecting the environment, and in particular protecting people's rights as the path to human security and the foundation, in the long term, for global security," said Jonathan Lash, president of the World Resources Institute, in his keynote speech at the Third National Conference on Science, Policy, and the Environment: Education for a Sustainable and Secure Future, held 30–31 January 2003 in Washington, D.C. In Lash's view, too few people make the connection among these three realms, and it is the role of the educational system to begin reversing that lack of insight.

P. Lynn Scarlett, assistant secretary for policy, management, and budget at the U.S. Department of the Interior, and others advocate experiential learning as a leading means to build durability. For example, students studying an ecological system in a field-based curriculum could see the consequences of pollution firsthand. This allows students to feel connected to the environment and, importantly, to see that their actions matter. One simple and successful

program, "Birds in the Hood," lets urban children and teens help scientists at the Cornell University ornithology lab count and identify neighborhood birds. Meanwhile, others including David Orr, chair of environmental studies at Oberlin College, encourage education that teaches students to "connect the dots"—to think in terms of the big picture and how they themselves fit into the systems and patterns of the environment.

Panelist Dee T. Allsop, CEO of Wirthlin Worldwide, renowned for his marketing research efforts, believes educational methods that create a personal relevance and emotional connection will spur change. "Information is critical because it leads to rational thought, which leads to change in the way that people see things," he says. "But that is secondary to touching people emotionally."

The educational system, along with society in general, still treats the Earth as if it's an infinite resource, said Ray Anderson, chairman of flooring company Interface, at the meeting: "The universities—in their academic programs, credit requirements, curricula, course design, campus design, and campus operation—perpetuate this flawed mind-set from generation to generation, with scarcely a pang of conscience, much less a serious

reexamination of [schools'] role in the destruction of the biosphere."

Although several panelists cited many exceptions at all levels of education, the consensus seemed to be that achieving sustainability will depend on broad reform of the educational system, in both how it functions and what it teaches.

The meeting of some 800 scientists, educators, policy makers, business people, government officials, environmentalists, and community leaders was sponsored by the National Council for Science and the Environment, the National Oceanic and Atmospheric Administration, the U.S. Geological Survey, and the U.S. Environmental Protection Agency Office of Research and Development. The conference produced recommendations on educational reform for the United States and for the United Nations in enacting its Decade of Education for Sustainable Development (2005–2015). These recommendations are available online at <http://www.ncseonline.org/ncseconference/2003conference/> and will be compiled into a report and distributed to Congress, federal agencies, and educators at all teaching levels.

The recommendations include infusing sustainability education into all levels of education, from kindergarten through advanced degree programs. Professional development in these areas must be supported, and inclusiveness and diversity in all aspects of education (including content, participation, disciplines, and approaches) promoted. Sustainability concepts must be incorporated into existing accreditation systems, and curricula need to be developed, including content, materials, and tools such as case examples and identification of best practices. And the learning isn't limited to schools by any means. Business leadership for sustainability should be fostered, too, by linking sustainability and stakeholder values and presenting case examples in training, education, and development.

Other key recommendations generated at the conference include developing messages that connect sustainability to core human values, implementing sustainable practices at educational institutions and other federal and private organizations, developing criteria to measure progress, and securing funding and other incentives for implementation of the recommendations. —Julie Wakefield



**Core curricula?** Education leaders met recently to discuss ways to better incorporate sustainability lessons and understanding into curricula and practices at educational facilities.

PhotoDisc

## REGULATIONS

## Terminating e-Trafficking

In December 2002, when the U.S. Environmental Protection Agency (EPA) ordered American Biotech Labs of Alpine, Utah, to stop selling a product advertised online as an “anthrax killer,” it was the fifth time in a 12-month period that the agency had ordered an Internet vendor to stop the sale of such a product. There are no registered products that control anthrax, but the recently highlighted risk of bioterrorist attacks has created a tempting marketplace that some online advertisers seek to exploit with unregistered products bearing unproven claims. And thanks to the ubiquity of Internet access, a frightened public has vast opportunities to locate and purchase these goods.

In fact, the problem of illegal Internet pesticide sales is far broader than a few websites selling bogus anti-anthrax products. Concerned by the proliferation of websites making questionable claims about the pesticides they were selling, the EPA and state health officials embarked

on a program in early 2001 to identify and stop offending sites. Their purpose is to ensure that pesticide sales comply with the requirements of the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). If they find anyone—a company, a person, or an auction site—making unaccepted claims, such as purporting to kill anthrax, the seller may be ordered to stop and may face civil and criminal penalties, including fines, for offering to sell an unregistered pesticide.

The EPA's focus on electronic commerce, or “e-commerce,” has grown as Internet sales have increased. About two years ago, a few state pesticide control officials decided to address the proliferation of websites selling chemicals with dubious powers. “There were an alarming number of websites of companies that were selling misbranded pesticides, unregistered pesticides, and restricted chemicals being sold to uncertified applicators,” says Tim Creger, a program manager with the Nebraska Department of Agriculture. “Everything that our state and federal pesticide programs are designed to regulate was

being counteracted on the web.” Creger is active in the Association of American Pesticide Control Officials (AAPCO) and began pushing for greater attention to the new regulatory challenges on the Internet. As a result, AAPCO created an Information Technology Committee, and Creger was named to head it.

AAPCO and the EPA joined forces on the e-commerce issue very quickly, and in June 2001 both groups set aside one day, which they called Surf Day, when the teams in federal and state pesticide control offices spent the day surfing the Internet in search of sites that may not have been FIFRA-compliant. When the day was done, the list of suspect sites numbered more than 600.

The next step was the creation of a “shot across the bow” letter. The letter is sent as an e-mail message that informs website operators that they may be violating the law and that by clicking embedded links in the letter they can learn more about how to comply with federal and state laws.

According to Creger, all sites that were found to present a significant regulatory concern were contacted. Many have taken steps to comply with the laws; the others

are involved in actions.

It's not that the Internet has created new legal turf beyond the reach of rules and laws. As Creger says, “It's just expanded the exposure of the illegal activity to the world. Now the little bathtub operation in Kokomo can go worldwide, and you can have a big problem.” According to Ann Pontius, director of the EPA's Toxics and Pesticides Enforcement Division, Internet activity that is illegal under FIFRA essentially falls into three categories: the sale of unregistered products, the making of unaccepted claims about the registered pesticides being sold, and the sale of restricted-use pesticides to people who aren't certified to use them.

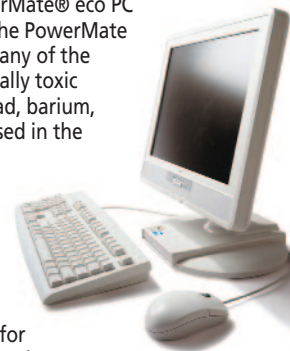
Tom Hall, stewardship director for CropLife America, a pesticide industry trade association, says that reputable manufacturers and distributors are also concerned about illegal websites. “Any two people with computers can get into the e-commerce trade,” he says. “We're just as concerned as the EPA is about that.” —Richard Dahl



**Debugging the web.** Regulators are stepping up efforts against online traffickers in illegal pesticides.

## Green Desktop

NEC Solutions America recently introduced the PowerMate® eco PC to the U.S. market. The PowerMate eco is made without any of the estimated 36 potentially toxic chemicals (such as lead, barium, boron, and cobalt) used in the manufacture of conventional computers. This means reduced health threats for production workers now as well as less hazard in the future for disassemblers or—if units are improperly discarded in landfills—the environment. The “all-in-one” units consume less energy, produce less heat, and comply with the U.S. EPA's Energy Star program.



## High on Hydrogen

On 10 October 2002, European Commission officials announced the formation of the High Level Group on Hydrogen and Fuel Cells. The group—which includes industry, research, government, and user association representatives—will develop a regional policy and action plan for the development and implementation of alternative fuel technologies in Europe. By June 2003, the group should be prepared to outline a research strategy that addresses safety, improvements in efficiency and performance, and marketing strategies to promote the alternative fuels. The EU currently imports 50% of its fossil fuels. Hydrogen and fuel cells could provide more sustainable and secure energy in light of projections that global demand for electricity is expected to double by the year 2015.

## EUGENE Label Means Clean Power

Europeans can now be assured that the “green” electricity they choose to buy really is more sustainably produced. Environmental and consumer organizations have joined with researchers to form the European Green Electricity Network (EUGENE), an independent group that accredits national labeling programs and certifies electricity suppliers. To carry the EUGENE label, all electricity sold by a supplier must come from solar, wind, geothermal, or carbon-neutral biomass sources, approved hydropower facilities, or (in certain instances) natural gas-based cogeneration. To support the building of alternative energy infrastructure, EUGENE also stipulates that a certain percentage of each certified supplier's power must come from new plants.





## MOLECULAR BIOLOGY

## Engineering Allergy Relief?

A new engineered protein known as GE2 may pave the way for future advances in allergy treatment. Since first describing the protein in the May 2002 issue of *Nature Medicine*, cocreators Andrew Saxon, director of the Asthma, Allergy, and Immunologic Disease Center at the University of California at Los Angeles, and Christopher Kepley, an assistant professor of internal medicine at Virginia Commonwealth University in Richmond, have tested GE2 in several model systems for allergic reactions, with highly promising results.

Saxon, Kepley, and colleagues constructed GE2 by combining FcεRI and FcγRIIb, which are receptor binding regions of immunoglobulin E (IgE) and immunoglobulin G, respectively. Both immunoglobulins have receptors on human mast cells and basophils, key players in allergic reactions. Whereas FcεRI triggers cells to release histamine and set off allergic events, FcγRIIb blocks the release of histamine. Saxon likens GE2 to connecting the gas pedal and brakes of a car: both are engaged, with the net effect of a slowing or cessation of allergic reactions such as sneezing, swelling, wheezing, itchiness, inflammation, and anaphylactic shock.

In the first proof-of-concept experiments, GE2 prevented the release of histamine in human basophils sensitized to nitrophenylacetyl (NIP), an allergen that Kepley likens to pollen in its effects. One microgram of GE2 per milliliter of growing medium cut histamine release by about half, and 10 micrograms per milliliter cut it by an average of

84%, compared to untreated cells. GE2 also reduced the severity of allergic skin reactions in NIP-sensitized mice by two- to fourfold.

More recently, the researchers showed that GE2 blocked the secretion of IgE antibodies by human B cells. High blood levels of IgE antibodies are a strong predictor of allergies, says Kepley. GE2 also suppressed histamine release from human lung mast cells, a good model for asthma, and blocked the release of interleukin-16 in Langerhans-like dendritic cells, which contribute to inflammatory allergic processes in the skin. These yet-unpublished findings were presented at the 60th annual meeting of the American Academy of Allergy, Asthma, and Immunology in March 2003.

Moreover, the FcγRIIb portion of GE2 can be fused to specific proteins to target specific responses, such as allergic reactions to cats or peanuts. Kepley and Saxon have created transgenic mice that were made allergic to cats through binding of human allergic antibodies as well as mice that were immunized with cat protein and therefore became “naturally” allergic. Then they engineered a chimeric fusion protein called GFD composed of FcγRIIb and the cat allergen Fel D1. The GFD protein blocked allergic reactions when either type of mouse was exposed to cat allergens. Similarly, GFD prevented histamine release by basophils taken from cat-allergic humans. Work is also under way to design comparable proteins to prevent peanut allergies. Kepley foresees GE2-based allergy treatments being injected like allergy shots currently in use.

“It’s cutting-edge research that could lead to new ways to treat allergic diseases,” says Marshall Plaut, chief of the Allergic Mechanisms Section at the National Institute of Allergy and Infectious Diseases. However, Plaut cautions that these molecules may not work equally well in all models. Other unknowns also need to be worked out, such as whether blocking signaling pathways with GE2 could lead to unforeseen adverse effects. —Carol Potera



**A game of cat and mouse?** Researchers looking for new allergy treatments are using novel model systems to learn how to prevent reactions.

## GENETIC RESEARCH

## Pinpointing DDT Resistance

Insecticide resistance is a major global health issue, with 40% of the world's population at risk for malarial diseases carried by *Anopheles* mosquitoes and these disease vectors showing increasing resistance to DDT. Now research published in the 27 September 2002 issue of *Science* shows that, at least in some strains of the fruit fly *Drosophila melanogaster*, overtranscription of a single gene may confer low to moderate DDT resistance.

Using microarray analysis, the researchers examined the activity of all 90 P450 genes, which control metabolic functions including chemical detoxification. Focusing on two strains of *D. melanogaster*, they found that not only did DDT resistance coincide with overactivity of the P450 gene *Cyp6g1*, this upregulation also conferred resistance to two other types of insecticides that mapped to the same genetic region as *Cyp6g1*.

The researchers sequenced the two DDT-resistant strains and found the same mutation

in each: the insertion of the *Accord* transposable element just upstream of *Cyp6g1* (such elements are small pieces of DNA that can jump to new genome locations). This upstream insertion could affect how often the gene was transcribed, and thus the amount of a detoxifying enzyme produced. They also showed that the insertion was present in 20 DDT-resistant fruit fly strains of diverse geographic origins. Most likely, the resistance developed “as a single mutagenic event some years ago” and has since spread globally, explains research team member Tom Wilson, an entomologist at Colorado State University.

The team produced DDT resistance in a line of susceptible fruit flies by inserting a copy of the *Cyp6g1* gene that was controlled by a heat shock driver. After exposure to heat, these flies transcribed the gene at 100 times the rate of nontransgenic fly strains and were resistant to DDT. The team interpreted these results to mean that “overtranscription of *Cyp6g1* alone is both necessary and sufficient for P450-mediated DDT resistance.”

But David Begun, an assistant professor of evolution and ecology at the University of California, Davis, comments that for the particular transgenic flies created, the upregula-

tion of *Cyp6g1* was sufficient; he disagrees that the experiment demonstrates that upregulation is necessary for DDT resistance. This research likely reveals only part of the DDT-resistance story, he says.

In a highly resistant *D. melanogaster* strain investigated by Amy H. Tang, an assistant professor at the Mayo Clinic Cancer Center, a retrotransposon was found to be inserted in the same upstream location as the *Accord* element described earlier, and it too upregulated the *Cyp6g1* gene. However, when Tang produced recombinant lines lacking the retrotransposon, she found that, despite the expected lack of *Cyp6g1* upregulation, the strains were still highly DDT-resistant.

Tang agrees that upregulation of the *Cyp6g1* gene is able to confer low-to-moderate levels of DDT resistance. However, she says, upregulation of *Cyp6g1* clearly is not necessary to ensure DDT resistance at high levels in the strain she investigated. “Most likely, upregulation of detoxification enzymes alone is not responsible for conferring the high level of DDT resistance we observed,” Tang says. “Our results are pointing to multiple mechanisms of DDT resistance besides detoxification.” —Anne M. Rosenthal

## ehpnet

## National Council for Science and the Environment

The National Council for Science and the Environment (NCSE), a non-governmental organization based in Washington, D.C., works to develop and promote a comprehensive and integrated scientific basis for environmental decision making. The NCSE, which is supported by nearly 500 government, academic, business, and environmental organizations, is particularly interested in advancing ideas from diverse communities to facilitate understanding of environmental issues. Its website, located at <http://www.ncseonline.org/>, offers insight into the group's policies, academic programs, and other activities, including its annual National Conference on Science, Policy, and the Environment.

From the Science Policy page, visitors can access archived news articles on congressional and presidential actions on science policy, NCSE testimony before Congress and the President's Council on Science and Technology, the council's *Handbook of Federal Funding for R&D*, and back issues of the council's monthly *Science, Environment and Policy Report*. Visitors can also access more than 1,200 Congressional Research



Service reports covering a broad range of topics including climate change, pesticides, pollution, risk and reform, transportation, and waste management. These documents are prepared specifically for Congress and are written so that non-scientists can easily understand the science behind policy-making initiatives. They are available to the general public only through this website.

The NCSE National Library for the Environment (NLE) link on the homepage is a portal to yet more information. This portion of the site includes a link to the NCSE Native Americans and the Environment project, which is aimed at educating the public about environmental problems encountered by Native American communities and about the Native American perspective on environmental issues. The PopPlanet and PopEnvironment links go to information on population issues and how they can impact the environment. Visitors can search a bibliography and abstracts of more than 14,000 publications and other materials on population or peruse population, health, and environment profiles of 15 countries in Africa, Central America, and Southeast Asia. Each profile includes an overview of the country's specific environmental issues, laws, and treaties, links to nongovernmental organizations working with the country, and information sources for pertinent environmental issues such as desertification, human health, and marine issues/fisheries.

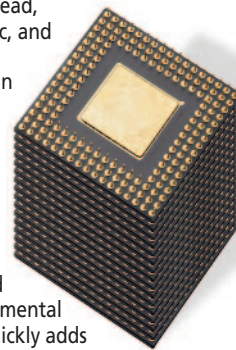
Nearly 3,000 Internet-based information sources can be accessed through the Reference Resources link on the NLE page. These sources are organized by category (for example, environmental journals, reports and data, treaties, photographs) and searchable by keyword and phrase. The Toxicology Resources link leads to more specialized information on topics including brownfields, state cancer registries, and state toxic chemical release inventory programs.

Back at the main NCSE page, visitors can find information on the Council of Environmental Deans and Directors, an NCSE-sponsored professional organization of leaders of college and university institutes of environmental studies. With more than 100 members, the Council of Environmental Deans and Directors facilitates the exchange of research findings and ways to bolster interest in interdisciplinary environmental education and research among not only students but also policy makers, industry, and nongovernmental organizations.

The Minority Programs link on the homepage brings together resources on national and international environmental justice initiatives and grant opportunities, and includes access to resource directories on specific environmental and educational subjects. The About These Programs page details how the NCSE works with more than 300 colleges and universities serving minority populations to help develop research and outreach programs tailored to their unique needs. —Erin E. Dooley

## Chips' Impact Stacks Up

The resources employed in turning raw quartz into silicon-based computer chips include fossil fuels, water, and chemicals including potentially toxic solvents, lead, chromium, mercury, arsenic, and silica. Researchers at the United Nations University in Tokyo have determined that the production of one 2-gram chip requires 700 times the chip's weight in materials. Compound that number by the 20 million-plus computers being discarded each year, and the environmental price of computer chips quickly adds up, especially considering that computers are often not recycled. In comparison, producing a typical automobile requires twice the vehicle's weight in materials.



## The Weight of the World's Tobacco Use

Worldwide, tobacco use contributes to the deaths of 4.9 million people every year—or 560 people every hour. This number is expected to reach 8.4 million per year by 2020, with more than 70% of these deaths occurring in developing countries. To give policy makers, researchers, and health professionals a look at the global dimensions of this epidemic, the WHO, in collaboration with the U.S. CDC, unveiled *The Tobacco Atlas* in October 2002. This compendium of trend data outlines in maps and other graphics the health risks and costs linked with smoking and environmental tobacco smoke, types of tobacco use, age and sex differences in tobacco consumption, and the tobacco trade. The agencies intend the atlas to help policy makers formulate national and international regulations on tobacco control.

## Asthma in Elders

The U.S. EPA has awarded \$85,000 to the National Indian Council on Aging to assess environmental health threats of particular concern to Native Americans and Alaskan Natives. One focus of the project will be the environmental factors that can trigger asthma attacks. Research from the National Resource Center on Native American Aging has revealed that Native American elders are 44.3% more likely to report asthma than the general population. The project, which will be based at the University of New Mexico, will promote awareness among the populations concerned as well as develop recommendations for addressing these environmental health hazards.

